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ABSTRACT

The purpose of this study was to find the beliefs of Chinese teachers in mathematics education and their impact on the practice of teaching. The objectives of the study were to recognize views of Chinese teachers on goals of education, especially goals of mathematics education, to explore how Chinese teachers prepare a lesson, examine how mathematics is taught in Chinese classrooms, and investigate how Chinese teachers instruct with different levels of students. The ultimate goal of this study was to focus on the importance of teachers' beliefs and their impact on the practice of teaching, and to provide data and recommendations which may be used to identify problems in mathematics in American and Chinese schools. Results indicate that teachers' beliefs about mathematics and its teaching play a significant role in shaping the teachers' ways of instruction, and cultural and social contexts affect teachers' belief systems. (Contains 10 references.) (ASK)

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Mathematics Teachers' Beliefs and Their Impact on the Practice of Teaching in China

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on the Practice of Teaching in China

Introduction

Mathematics education in different countries is strongly influenced by cultural and social factors that build goals, beliefs, expectations, and teaching methods. Because of social and cultural factors, there may be some differences in domestic issues in different countries (Sekiguchi, 1998). The differences include the designing of curriculum, the use of textbooks, and the teaching methods. There are also similar issues in education that many countries share. For example, many countries have the view that the beliefs of mathematics teachers have a powerful impact on their teaching (Paul Ernest, 1989). Since 1980, many researches in the United States, have focused on the teachers' beliefs about mathematics teaching and learning (Thompson, 1992). The assumption among these studies is that "to understand teaching from teacher's perspectives we have to understand the beliefs with which they define their work" (Nespor, 1987). According to Paul Ernest (1989), "during the teachers' transformation into practice two factors affect these beliefs: the constraints and opportunities of the social context of teaching, and the level of the teacher's thought." Different cultures and societies have different philosophies regarding the teaching and learning of mathematics. These variations of the beliefs and values concerning mathematics education result in different educational systems.

In general, the U.S. has viewed Asian countries, including China, as having a superior educational system, especially in mathematics. For example, the third

International Mathematics and Science Study (TIMSS) revealed in 1998 that U.S. eighth and twelfth graders score below average in mathematics compared to 41 nations in the TIMSS assessment. Therefore, mathematics education in the U.S. needs to shift its attention internationally to find ways to improve mathematics education and to compete globally.

The purpose of this study was to find the beliefs of Chinese teachers in mathematics education and their impact on the practice of teaching. More specifically, the objectives of the study were to recognize views of Chinese teachers on goals of education, especially goals of mathematics education, to explore how the Chinese teachers prepare a lesson, to examine how mathematics is taught in classrooms in China, and to investigate how Chinese teachers instruct in different levels of the students. The ultimate goal of this study was to focus on the importance of teachers' beliefs and their impact on the practice of teaching, and to provide data and recommendations, which may be used to identify problems in mathematics in the schools of the U.S. and China.

Methods

Research Design and Questions

In May of 1999, we were invited by the Ministry of Education in China to go there to present mathematics teaching methods to a group of Chinese educators and researchers. This allowed us to have an opportunity for discussion, sharing, and debate of the important issues in the teaching of mathematics. Research questions included: (1) what are Chinese teachers' views of the goal of education, especially, the goal of mathematical education? (2) What are Chinese teachers' views of effective instructional method and what instructional methods do Chinese teachers like to use in mathematics

teaching? (3) How do they prepare the lessons and how long do they spend on preparation and grading daily? (4) How do they view the textbooks and curriculum, and how flexible are they in following the curriculum guideline in teaching? (5) How do they deal with students' mistakes in learning mathematics, and how do they treat different levels of students, especially students who have difficulties in mathematics? And (6) What are their educational backgrounds in mathematics? With these research questions, the study combines both qualitative and quantitative research designs to examine mathematics teaching practice in China. The primary focus of this study is to identify how Chinese educators teach mathematics.

Data Source and Procedure

I visited five schools, had five group discussions, interviewed 30 educators and researchers, surveyed 18 teachers, and observed 10 different levels of mathematics classrooms in China.

Descriptive information and intervention data were gathered through use of qualitative and quantitative research methods. The qualitative methods included observations, interviews and surveys. The quantitative data were collected from analyzing surveys.

Significance of Findings

This study finds that Chinese teachers' beliefs of mathematics education have a strong impact on their practice of teaching.

Goals of Mathematics Education

This study found that the majority of Chinese teachers in the study believe that the goal of education in China is to cultivate people and increase the quality of the whole

nation. Specifically, the goal of education should foster students' development in five areas: moral, academic, physical, aesthetics, and work while at the same time focusing on the expansion of the students' creative ability. Most teachers in this study agree that the goals of mathematics education are to develop the students' thinking ability and creative ability, and to help students use these abilities to solve real world problems. An example of one teacher's thinking highlights this goal: Mrs. Wang thinks that the goal of mathematics education is to teach students how to think and research, and how to use mathematics as a tool for other subjects. With this goal, teachers strongly emphasize basic concepts and skills in Chinese mathematics education. Their goal is not only to teach students how to do something and also to understand mathematical concepts so that they can solve future problems.

Preparation of Instruction

Teachers in China pay much more attention and time to preparing instruction. Although the numbers of students are doubled in each classroom compared to the U.S., teachers have only two classes daily. Most teachers in this study spend about 2-3 hours on preparing a lesson every day at school. Every teacher works on the preparation at home for at least one hour. For example, Mrs. Li spends 2-3 hours at school and one hour at home preparing for the next day's instruction. The sufficient planning time enables teachers to understand the subjects and their requirements fully, so they can prepare the instruction thoroughly. In the lesson plan, teachers write details about each sentence they are going to say to students from the beginning of class to the end, the step by step instruction of each problem, and the important parts and difficulties of the lesson. Mrs. Cheng's lesson plan on "a whole number multiply a fraction" has five pages,

including 1. Content, 2. The Objective, 3. Materials, 4. Procedure (a) review (b) lesson (c) reinforce practice (d) summary (e) homework.

Confucius' philosophy has played an important role in Chinese education. According to Confucius, "When walking in the company of three people, there must be one I can learn something from. I shall pick out his merits to follow and his shortcomings for reference to overcome my own" (Cai & Lai, 1994). Under the influence of Confucianism, teachers share their ideas about the teaching with colleagues and learn from each other. In the school, teachers usually have informal discussions with other teachers, and an instructional meeting at least once a week. Most school districts and cities also have open-classes for teachers once a month. These open-classes are taught by experienced teachers working with other school's students. All teachers can apply to teach open-classes as long as they have new ideas and new ways to teach mathematics effectively. After teachers attend open-classes, they will give their comments on the classes and ranks of the classes for the awards. It also helps the teachers who give lectures for the open-classes to improve their teaching.

All the teachers in this study spend about 2 hours grading their students' assignments at schools. Some teachers even spend more time on grading their students' work. As an example, Mrs. Zhong has been teaching for three years. She says that besides teaching two classes every day, she spends the rest of the time at school grading students' assignments, about 4 hours daily. All teachers grade each problem of the students' work. They point out the mistakes in the problems and praise what is done well. Then they record and analyze the students' mistakes in their work, thereby establishing the patterns of errors. By analyzing the students' errors to class, teachers provide

feedback to students immediately and help students learn from their mistakes. Students are required to make corrections in their mistakes after they receive the teachers' feedback. According to Ashlock (1994), "Errors are a positive thing in the process of learning--or at least they should be. In many cultures, errors are regarded as an opportunity to reflect and learn." The Chinese culture promotes learning from errors. The famous idiom "failure is the mother of success" reflects the Chinese attitude toward mistakes. According to Mrs. Wang, if most students have the same errors, she will evaluate her own teaching method and find a way to improve her teaching; if there is only one individual error, she will talk to the student and find out why the student makes such mistakes and give tutorials to this student. Mrs. Chu, with 34 years of teaching experience, says that she uses statistics to analyze the type of errors, percentage of errors, and the factors of errors. And then she will analyze: 1. Which errors may be caused by her teaching ignorance and approach? She will find ways to improve immediately. 2. Which errors are caused by the lack of prerequisite knowledge, which she calls "blind point of the knowledge? " 3. Which errors are caused by the learning habit of students? According to the errors of students, she makes strategies to prevent the recurrence of errors. She usually encourages the correct answers by praising and displaying good works. For a student having difficulty, she uses the "interview" way of grading. She grades student's work in front of the student, talking with the student, and helping the student understand what is the correct way to do the problems. She always tries to nip the "blind point" in the bud. This way, students will not make further mistakes if the teacher can help students realize and eliminate errors in the early stage.

Although each teacher has more than 50 students in each class, grading students' assignments lets the teachers know the level of their students' abilities very well. They pay attention to the different levels of students, especially students who have difficulties in mathematics. Most teachers use one on one tutorials to help students with difficulty in learning. They use the strategy "focus two ends, develop the middle" to treat the differences among students. However, Mrs. Wang thinks that focusing on the top and low levels of students often ignore the middle level of students. Mrs. Zhong also uses "one on one" strategies to group students and have students help each other and learn from each other at school and outside of school.

Classroom Teaching

The result of this study indicated that most Chinese teachers use a traditional way of teaching mathematics. This traditional way is the heuristic method, in which a teacher inspires students to think deeply and to learn actively. Chinese teachers feel that the heuristic method, a rigorous and solid method, can build a strong foundation in the basic knowledge, computation, and systemic analysis through a step by step process. However, under the pressure of an examination system, most teachers focus on achieving a high rate of success on the entrance examination. Their teaching becomes teacher-centered, which often ignores the functions of students, neglects the development of character of the individual, lacks the cultivating of creative ability, disconnects learning with students' real life, and overlooks the interchange relationship between teacher and students. Especially, under the influence of an exam-driven system, the objectives of teaching do not consider students' interests. In order to teach large amounts of content, teachers often

give many exercises to students, which result in the teacher instilling knowledge in the students and some students losing interest in learning.

According to the teachers in the study, they realize the disadvantages of their teaching methods. They strongly hope to improve the way they teach by learning from American educators. These include using manipulative activities in the class, focusing on the development of creative ability, paying more attention to individual student's needs, building connections between knowledge and the real world, and solving real world problems. Most teachers in this study would like to change their teaching. Mrs. Li has 6 years of teaching experiences in mathematics at the elementary school. She thinks that the most efficient teaching method in mathematics is heuristic-discovery method, but she uses the teacher-centered method. She wants to try the discovery method in teaching mathematics. She says that "we should have an awareness of reformation, change gradually, absorb the good experience from others, and keep our own characteristics." Mr. Fang, who has 11 years of teaching experience, considers that there is no definite way for teaching mathematics. The teaching method which a teacher uses should be according to the background of students and subjects. He likes to use the "cooperative learning and competition" and "problem-solving" methods in teaching mathematics. In the 34 years of teaching mathematics, Mrs. Dong usually uses the heuristic method. It creates the question scene, promotes students' interest in learning, and helps students find the reason and rule through hands-on, thinking, sharing, discussing, and question. She thinks that teachers should encourage students to participate in learning and to become the real masters in their learning; teachers not only help students understand mathematics, but also should help students learn how to study.

Although there are many difficulties in reforming teaching methods, such as too many students in each class, each teacher in this study would like to try using a new way to teach. They realize that in order to change efficiently, the whole educational system must be reformed.

Textbook Reforming

For the past few decades, China has used a unified set of textbooks. However, in recent years, China is publishing different sets of new textbooks for use in schools. There is still a systematic emphasis on the basic concepts and skills in the Chinese textbooks, which allows teachers and students to build a strong foundation towards a comprehensive, solid, and deeper understanding of mathematical knowledge. However, this emphasis is bound by a lack of hands-on activities and limited exposure to new technology. Most teachers in this study are satisfied with new textbooks and curriculum, but they have to follow curriculum closely in order to accomplish the instruction. Most of them use supplementary materials in teaching; some of them adjust the order of contents in the textbooks according to level of difficulty. However, some teachers complain that new textbooks would reduce the level of difficulty; some problems are too difficult for students and disconnected from the real world; some textbooks do not have an appropriate level of difficulty. New textbooks will make middle and low levels of students experience difficulty, and the textbooks contain too much content for a specific instruction time. Teachers hope that the department of education in China allows schools and teachers more space and freedom to adjust the curriculum.

Educational Backgrounds

According to Shulman (1985), "To be a teacher requires extensive and highly organized bodies of knowledge." Elbaz (1983) has the same view: "The single factor which seems to have the greatest power to carry forward our understanding of the teachers' role is the phenomenon of teachers' knowledge."

In the study "Knowing and Teaching Elementary Mathematics: Teachers' Understanding of Fundamental Mathematics in China and the United States," Ma (1999) observes that Chinese teachers, although having studied far less formal mathematics than teachers in the U. S, tend to develop a "profound understanding of fundamental mathematics."

The result of the survey in this study indicates that 90% of teachers (teacher 1st to 6th grade) have 2 or 3 years of college education. Few of them have only a high school degree. However, most of them have at least 4 mathematics courses in college. The courses are Calculus, Elementary Analysis, Modern Algebra, Statistics, and Computer.

According to a Chinese idiom, "If you want to give the students one cup of water, you should have one bucket of water of your own." Teachers in this study realize that teachers should not be satisfied with "one bucket of water." They should look for the "continuous flow of water" to prepare fully. Therefore, teachers always look for the opportunities to continue their education. During the school year, most teachers attend the professorial development workshops at least 2 to 5 times. Some of them take courses at universities in the evenings or weekends to gain more knowledge for teaching.

Educational Significance

The results of this study support the idea that teachers' beliefs on mathematics and its teaching play a significant role in shaping the teachers' ways of instruction (Thompson, 1992). In general, this study indicates that cultural and social contexts affect teachers' belief systems (Paul Ernest, 1989). Mathematics educators from different cultures and countries have their own beliefs; therefore, they develop their unique teaching approaches, which may be viewed as backward by others. In addition, this study supports the call from Jiang & Eggleton (1995) that now is the time for mathematics educators to learn from cultural differences and gain insight into mathematics practices of teaching. In order to increase the pace of the process of globalization in education and to achieve success in the high competition of global economy in the 21st century, China is now reforming the national mathematics from the perspective of globalization with an emphasis on their own characteristics.

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